TO: HM
FROM: DML
SENT: 02 MAR 83 01:28:11
READ: 02 MAR 83 04:55:56

Hank,

Thank you very much for sending me the 'AMICON LINK LEVEL PROTOCOL NOTES'. I am still a little confused about whether this protocol is the same as the one called, 'AX-25'. After looking at the layout of the frame I came up with a number of questions but I will withhold expressing them until I can find a copy of the ANSI Standard Document X3.66 describing ADCCP.

I have searched here for this document but I have been unsuccessful in locating a copy. The notes say that it should answer questions about the protocol and I would certainly like to read it rather than comment without all the facts available to me.

Recently I have changed direction in my efforts to develop protocols for Amateur Radio Digital communications. Previously, I had been talking and advising others on what I thought should be done. I also wrote a few articles describing my proposals and commented on other ideas. Since I was dealing with the total requirements (i.e. the 7 levels of ISO protocols) I found that very few people understood the basic concepts of Digital Communication except at the very lowest of the layers. The response I got to my article in the Procedings of the first Conference was decidedly underwhelming Although there is a very active user group in this area (about 25 active and about the same number inactive or almost ready to go) I have been unable to influence them to develop higher levels of protocols other that level 1 and two which they were handed about three years ago.

After hitting my head against a brick wall for the last year or so I have finally realized that before I can communicate my ideas, I would have to undertake a massive education program of the Amateur Radio Digital Community locally. I considered doing this but finally decided that it would be just too much work and really doesn't get the Amateur Radio Digital Communications network going. I needed more direct methods. Besides, most of the users are very little interested in the details of digital communication protocols otherwise they would be out buying the textbooks and reading the technical articles - they aren't doing this.

And so, sometime in early January, I decided to return to the methods I was using in 1979 which were so very successful. At that time, my job was to write the software for the TNC and station node. My direction from the VADCG was only that I do it - they weren't interested in the details but only that it be done and done timely. We were all able to meet our objectives. I wrote the program in reasonable time and I was pleased and our group was pleased. And as you know, many others have made use of one of the programs that I wrote at that time.

In January I went back to this system and almost immediately it paid off. One immediate benefit was the program which is the subject of my paper for the Conference. My plan is to implement all levels of protocol on a CP/M system and the VADCG TNC. I mean all the levels or functions defined in the ISO standard from level 1 to 7 including some applications. I realize that it is ambitious but I think I can see a way of doing it. As I say, I have been making good progress so far. In any case, if I am less than 100% successful, there will still be a lot of benefits in the fallout. Also, I am getting more satisfaction out of doing the job than talking and demonstrating and lecturing and writing articles which don't seem to be getting the job done.

Don't wait for the complete Job to be done in a month or two. It will take longer than that but I should be able to bring out parts of the system every month or two. The parts will likely be changed as the rest of the

system develops. I realize that I will have to resist efforts by others to brins me back into the old patterns which I feel are non-productive.

I feel that some will want to label me as an elitist for the above ideas bu I feel that this method is workins much better for me. I really want to set the job done. I want to take the most direct approach and leave the mass education 'til later if it turns out to be necessary. I have decided to sive up lecturins at local radio club meetinss for the time beins. The bis exception to my plan is the ARRL Packet Conference which I am plannins to fully participate in.

Thats more than enoush for now. I will fill you in on some of the details when I see you at the Conference.

73 for now,

Dous, VE7APU/3

cc. Paul Rinaldo

29 Shamokin Drive,
Don Mills, Ont. M3A 3H7
February 12, 1983

Hank Magnuski, KA6M
311 Stanford Avenue
Menlo Park, CA 94025

Dear Hank,

This is in reply to your letter to Paul Rinaldo of June 10, 1981 a copy of which was sent to me and 11 others. It has been a while but I am finally responding to it. Paul has been faithfully distributing such correspondence and I am sending him a copy of this letter so that it may reach those who received your original letter.

When I received your letter from Paul I was heavily involved with the ANIK-B satellite link with Ottawa and the end of that overlapped with my move to Toronto so the reply got pushed way down my priority stack and finally got lost. All these and other considerations have been resolved and it now looks like I will be able to become increasingly more involved with Amateur Packet Radio in the future.

The subject of inter-network protocols has become more of a concern to me recently because I have begun work on implementation of a Transmission Control Protocol on my CP/M system and VADCG TNC and a part of this work is the subject of my paper at the forthcoming conference. I have reviewed all my correspondence and I have only been able to find one other response to your request for comments and that was from Stu Beal, VE3MWM whose response dealt mostly with the general philosophy of such protocols and not much with the details. I would be pleased to hear of any other written responses you received, if any. After publishing my suggestion regarding protocols in the proceedings of the first conference, I expected to get some correspondence but I received none so I would not be surprised to hear that Stu's response was the only one you got.

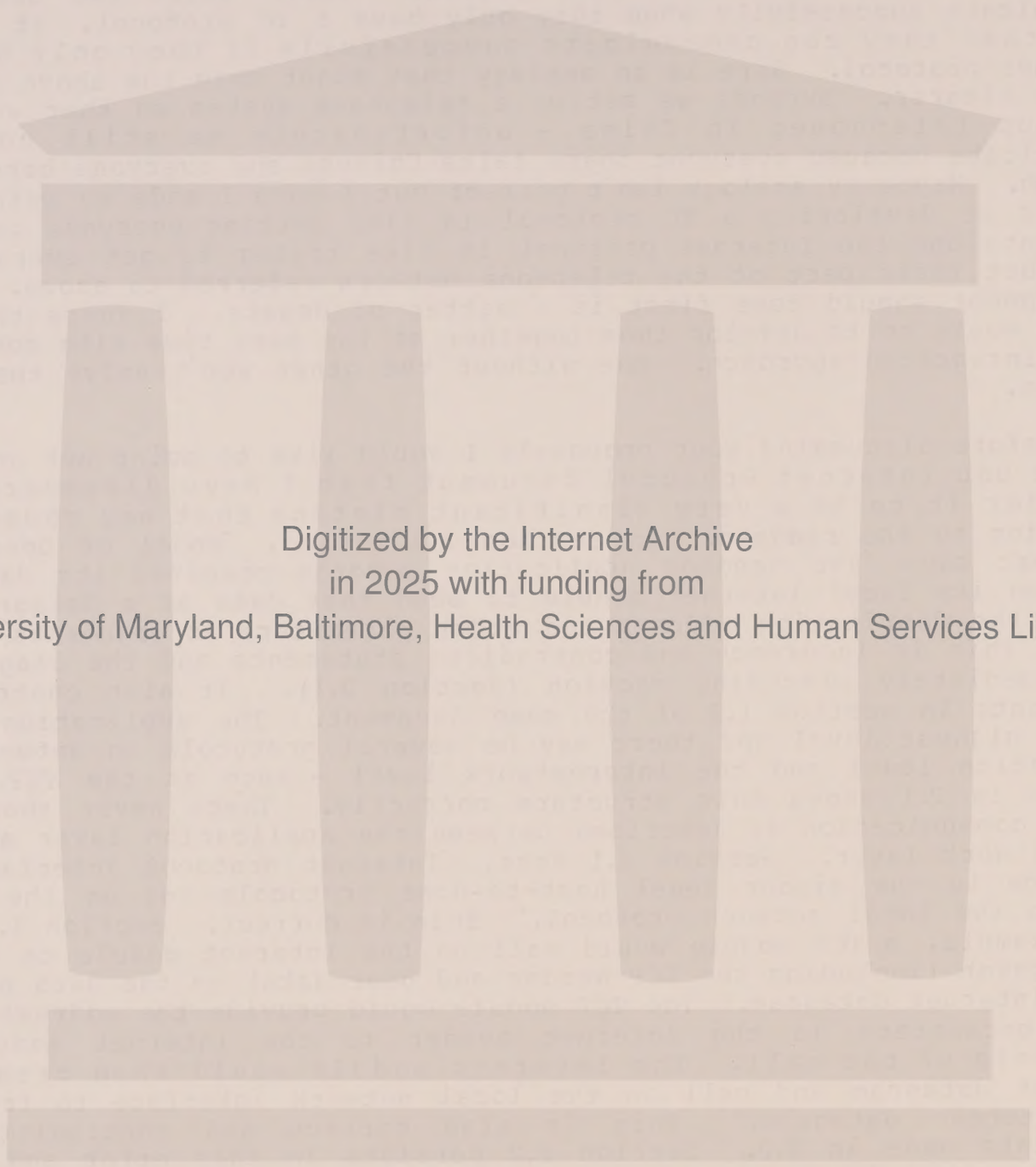
Maybe I can find an excuse for not replying to your letter found in your letter itself. On the bottom of page 2 you say, "...I would like to see some comments on why we shouldn't use it." Well, I think we should use it, so perhaps it could be construed that I should not be commenting. (Please note that this paragraph is intended as humour.)

My protocol suggestion dealt mainly with the Transmission Control Protocol and very little with the Inter-network protocol although the TCP (Transmission Control Program) must interface with the inter-network protocol. I need to implement a TCP which will be able to provide all the information the inter-network protocol requires to function even though the inter-network protocol is only required when information is entering or leaving the network. My hope was to get agreement on a Transmission Control Protocol which would mean that an inter-network

protocol would only need to be used when communicating with non-Amateur networks (foreign networks). The agreement on a TCP protocol would allow communication between application programs and permit the application programs using the network to be written.

The development of the Inter-network protocol before anyone has developed a TC protocol has some dangers. It tends to stress the differences between the networks rather than trying to make them talk to each other. Or, in other words, it tends to create a lot of separate networks rather than one large network. Also, while two users can communicate successfully when they only have a TC protocol, it is not true that they can communicate successfully if they only have an Internet protocol. Here is an analogy that might make the above point a little clearer. Suppose we set up a telephone system so that we could dial up telephones in China - unfortunately we still couldn't communicate because everyone there talks Chinese and everyone here talks English. Maybe my analogy isn't perfect but I hope I made my point. My efforts at developing a TC protocol is like getting everyone to learn Esperanto and the Internet protocol is like trying to get everyone to construct their part of the telephone network referred to above. Which development should come first is a matter of debate. I guess the best of all would be to develop them together at the same time with some kind of an integrated approach. One without the other won't solve the total problem.

Before discussing your proposals I would like to point out an error in the DoD Internet Protocol document that I have discovered. I consider it to be a very significant mistake that may cause some confusion to the readers. In section 2.2 titled, 'Model of Operation' the text says 'The sending application program prepares its data and calls on its local internet module to send that data as a datagram and passes the destination address and other parameters as arguments of the call.' This is incorrect and contradicts statements and the diagram in the immediately preceding section (section 2.1). It also contradicts statements in section 1.3 of the same document. The application level is the highest level and there may be several protocols in between the application level and the internetwork level - such as the TCP. The diagram in 2.1 shows this structure correctly. There never should be direct communication as described between the application layer and the internetwork layer. Section 2.1 says, 'Internet protocol interfaces on one side to the higher level host-to-host protocols and on the other side to the local network protocol.' This is correct. Section 1.3 says "For example, a TCP module would call on the internet module to take a TCP segment (including the TCP header and user data) as the data portion of an internet datagram. The TCP module would provide the addresses and other parameters in the internet header to the internet module as arguments of the call. The internet module would then create an internet datagram and call on the local network interface to transmit the internet datagram." This is also correct and contradicts the statements made in 2.2. Section 2.2 persists in this error and shows the same error in its Figure 2. and also states, "The internet module determines that the datagram is for an application program in this host. It passes the data to the application program in response to a system call, passing the source address and other parameters as results of the call." These statements are also incorrect. I am guessing, but I think the author of section 2.2 was confusing the application programs with



Digitized by the Internet Archive
in 2025 with funding from
University of Maryland, Baltimore, Health Sciences and Human Services Library

https://archive.org/details/corr-ax2-ic-tcp

the transmission control program. My recommendation is to ignore everything in section 2.2.

I am in very strong agreement with you on all your major points and I would like to even go one major step further and suggest that we also adopt a version of the DoD Transmission Control Protocol. It contains some excellent ideas and suggestions of methods and is very complete. I am planning to make a proposal around this protocol soon in a separate document. Now I will comment on the major points of agreement.

The 'datagram' is the only practical way of providing inter-network communications. A 'virtual connection' approach is out of the question because some of the networks Amateurs will want to communicate with or through will not be able to provide this facility and also because any packets that have been sent out of one network to another pass beyond control of the originating network. Once out of control of the originating network, it is impossible for that network to make any guarantee as to the sequence of packets that will arrive at the destination or whether they will arrive or whether any indication that they have or have not arrived will be returned to the originator. Please note that the above comments on inter-network datagrams does not apply to intra-network communications. Each network is still free to use either the datagram or virtual connection methods (or even both) for its own internal communications. I am not sure that this latter point is made clear in your letter. I am frequently guilty of confusing this point when I refer to a world wide Amateur Radio Digital Communications Network which will probably turn out to be a large group of networks communicating with each other. (A 'catanet')

I too agree with your proposal, "I propose that AMNET and AMICOM adopt the INTERNET standard intact, with a couple of minor extensions to solve some of our special problems." I have a slightly different idea as to how to solve these recognized problems which I will describe later.

I agree 100% with the several points mentioned in the paragraph headed 'First' on the second page of your letter.

In the next paragraph you say that it would make us compatible with DoD and some other networks to which we might eventually want to interface. This is only partially true because of the extensions you describe. The addressing requirements in the Amateur Radio networks and in the DoD and other networks are different as you say so it is necessary to use a gateway function of some kind when passing between these networks. Admittedly, the gateway would not have to be very complicated to do this job. This would allow us to pass packets through the DoD network and on to another amateur radio network. This pass-through function is quite a bit different from actually communicating with the hosts and users in the DoD network itself because that would require compatibility at the higher levels of protocol such as the Transmission Control Protocol. By providing a very simple bidirectional gateway function the amateur radio networks could reciprocally provide a pass-through function between two DoD networks as well. Both could provide a service for the other with no requirement of any knowledge of any higher level of protocol than the internet protocol. The gateway

would have to have knowledge of the addresses in both networks.

I agree with all the points raised in the paragraph which starts, 'Third' on the second page. The INTERNET document is one which we can build on. We both agree there are some changes required but the document is the best that we have available at the present time describing an internet protocol.

I also agree with all the points raised in the last paragraph on the same page where you bring up the question of Transmission Control Protocols. This is of course an entirely different subject which opens up a whole new set of considerations. I will be preparing another document on TC Protocols which will hopefully get more feedback than my last one.

On the third page you discuss the problems in applying the INTERNET standard to the Amateur Radio environment. I agree 100% with your identification of these problems in the area of addressing. The Amateur Radio environment must use call signs as at least part of the internet addressing/naming structure. I would like to propose a slightly different solution however.

The addressing structure you proposed has four components:

1. A single byte field containing a zero field or a constant for all the Amateur Radio networks.

2. A two byte field representing a geographic location to the nearest degree of latitude and longitude.

3. A one byte field assigned to each station in an area presumably assigned by a higher level of protocol or by committee.

4. A six-byte field containing the call sign of the station.

I propose an address structure with three components:
1. A six-byte field containing the call sign of the station similar to number 4 above.

2. A one byte ASCII field normally blank (20H) but will be used to represent different connections to the network by the same station. To quote the Internet Protocol document, "Care must be taken in mapping internet addresses to local net addresses; a single physical host must be able to act as if it were several distinct hosts to the extent of using several distinct internet addresses." Alternate physical and logical connections can be identified by changing this to another ASCII character or number. It can be looked upon as being part of the call sign for convenience for example: VE7APU1, VE7APU2, etc. A multi-homing feature can also be provided by ignoring this byte. I am not sure if this is what you intended by item #3 above.

3. A field representing the network or area that the station is in. The length of this field will be determined by the method of representation chosen as follows. (Choose only one.)

3.1. A one-byte network number chosen by committee. I would expect that 256 amateur radio networks would be enough for some time to come but..

3.2. A two-byte network number chosen by committee. This certainly would be enough for as far as I can see into the future.

3.3. A two-byte network number based on the geographical partitioning method described in your letter.

3.4. A three byte ASCII network name such as 'TOR' for Toronto or 'LAX' for Los Angeles. Something like airport naming. It may be used to identify foreign networks as well as areas or domains in the Amateur Radio network.

By giving a choice, I don't mean to leave everyone free to choose which one he wants to use. One of them should be chosen as a standard. I can live with any of them but I have a personal preference for choice 3.4 for the following reasons:

1. It's consistent with the other part of the address being a name that is readily understood by the end user of the system as is the call sign. It is very user friendly.

2. It will not require a look up table or directory on the part of the end user to make use of it as choices 1,2 and 3 will require.

3. I don't think that the internetwork naming and addressing is the proper place for routing information to be placed. In this respect I feel that we should not change the DoD Standard Internet Protocol. The routing system should be handled by another level of protocol and another mechanism. In the case of the DoD protocol standard it states that, "It is the task of lower level (i.e., local net or gateways) procedures to make the mapping from local net addresses to routes." The document does not deal with routing. I think the question to be asked is, 'Who are these fields going to be made convenient for - the user or the computer?' I think they should be made for the user. There are a number of other mechanisms that will work for routing.

The document states, "A distinction is made between names, addresses, and routes. A name indicates what we seek. An address indicates where it is. A route indicates how to get there. The internet protocol deals mainly with addresses. It is the task of higher level (i.e., host-to-host or application) protocols to make the mapping from names to addresses." As you will observe, neither of our proposals to solve the addressing problem pays strict attention to this discrimination. My solution uses names as addresses and so eliminates the need for higher level protocols to map names to addresses. This makes the 'addresses' longer however. The reason why I chose this way is because I thought as hard as I could and could not think of a practical way for separate networks to implement a mechanism whereby the names we need to use could be mapped to addresses. I assume that you did the same and came up with a similar conclusion judging by your proposal. The problem is that the call signs are so very important in the Amateur Radio environment but at the same time, they are too

randomly assigned and numerous. So I am taking the easy way out and calling them addresses.

To go back to the discussion of address compatibility and gateways. The addresses in one network are not compatible with those in another network just because they occupy the same number of bytes. In my proposal the addresses are obviously not the same length as those in the DoD network. Likewise in your proposal, the addresses are not the same length. You have hidden part of the address in the options field. I think the test for what part is an address is the answer to the question, "What parts of the header do I need to get the datagram to the destination host?" If you say the call sign is not part of the address because all the information is in the four byte field using the last byte to represent the call sign then the next obvious question is, "What mechanism is there for the source to learn the destination's four byte address without first using the call sign field to deliver the first datagram to the destination?"

The other problem is mapping the names to routes. There are a number of ways to do this. When the packet enters the network, the gateway can have a table mapping the names to routes. It only needs to map the three byte network/domain name to a route at this time because the call sign can be mapped when the datagram arrives at the destination network, area, or domain. In some situations it may not be necessary to map the call sign to a route at all. It may be sufficient to just broadcast the datagram in the local area where the destination will be able to hear it. This mapping task in many cases may be much simpler than it sounds depending on how the various areas of the network are linked together. For example in many cases there will be only one direction in which it is possible to transmit data so no mapping has to be done. So the datagram may be passed automatically along to where the mapping actually has to be performed. In other cases it will only have to be determined whether the datagram is for this area or some other area to decide whether to send it along or broadcast it locally. When a true mapping node is required it could insert routing information into the option field for this purpose. Very little route mapping will have to be done in actual fact until the time the network becomes extensive.

Even if two networks have the same length address fields and even if these fields contain sufficient information to get the datagrams to their destinations within each network, this still is not sufficient for compatability. Both networks must be able to understand the other address in order to be compatible. I will try to illustrate this using your four byte address scheme and a hypothetical situation where the Amateur network or networks is using the Arpanet to provide a pass-through facility between San Francisco and Washington, D.C. A datagram originating in San Francisco needs to be passed through the Amateur network in the San Francisco area, then into the Arpanet, through the Arpanet to the Washington, D.C. area, out of Arpanet and into the Amateur network in the Washington area and finally through the Amateur network to its destination in the Washington area. Using your address scheme everything will go fine until the Arpanet tries to move the datagram through its network. I don't know how the Arpanet determines routes from addresses but I am pretty sure it will have no way of handling the two bytes that represent geographic location to the nearest

one degree. The one byte network address won't help any either even if agreement with the DoD is obtained so they will recognize the address as belonging to an amateur radio network. To do this they will have to change the software in all the hosts in Arpanet and add code so they will understand the Amateur network addressing structure. The reverse situation is also true, the Amateur network does not understand the Arpanet addresses. The only practical solution to this problem is the use of a gateway as the internetwork protocol was intended to be used. The gateway has the ability to translate between the Amateur network addresses and the Arpanet network addresses - not necessarily all addresses but the ones we need to use. Making the addresses the same length in both networks doesn't really make this mapping process any easier. In fact it may make it more difficult because a four byte address may not be the most convenient length for the Amateur network. Please excuse me for perhaps belabouring the issue of compatability but it was suggested as one of the major reasons why we should adopt this protocol.

The Amateur radio network environment is unique. I think Stu Beal's observation when he quotes Kleinrock is very appropriate:

> "In our experiments ... we have occasionally attempted to adopt a protocol from one network directly over into a new network. We have found that this is a dangerous procedure and must be carefully analysed and measured before one adopts such a procedure. Indeed, the use of old protocols in a new environment is dangerous." (Kleinrock, op cit)

It looks like Stu has come up with a maxim for Amateur packet radio, "Adapt not adopt." It may be that we are doing too much adoption and not enough adaption in dealing with the DoD Internetwork protocol.

I think that intra-network routing should be the responsibility of the network concerned. In other words, when a packet from another network enters a destination network, that network should be able to deliver the packet to its destination using only the call sign in the internetwork header to direct it. The network I am working on uses a station node and will certainly be able to do this job and will also be able to send a message back if it cannot be delivered. However in the case where there is no real network, the internetwork packet can just be broadcast by the repeater represented by the network name, the station it is intended for will hear its call sign and respond. In this case however, no negative response will be provided if the station is not present to respond. (In true datagram fashion.)

To provide inter-network routing on the other hand, requires some kind of universal system that has to be agreed upon by the various networks to work. What that mechanism should be requires a major effort at agreement and should be the subject of a separate proposal. The alternative is the use of gateways.

I think I have commented on two of the four components of your proposal for addressing. The one byte network number field that is either zero or a constant yet to be assigned by the DoD I feel is entirely unnecessary and would only be of concern to the gateway function that interfaces with the DoD network. It is only useful while

the packet is actually passing through the foreign network and in fact all four bytes in the destination and source addresses will have to conform to the other network's standards while the packet is being handled by the DoD or other foreign network. i.e. this means the packet has been transformed by the gateway function. While it is on 'our' side of the gateway, this field is of no use.

In reference to the low order eight bits that will be assigned to stations in the same area: I feel that this one byte field is just a shorthand way of referring to the call sign field and so is redundant. The call sign uniquely defines the destination of the internet packet and is already present. The use of a shorthand form for the call sign has its uses in certain cases in intra-network communication however and the system I am working on will allow mapping of call signs to single byte addresses to use as link level addresses and shorten packet overhead by 10 bytes. But this function is not for the inter-network protocol. It should be kept a local matter in each network interface.

As to the format of the internet header: My proposal is to expand the source and destination addresses from four bytes to ten bytes each. (Assuming you use my preferred choice for the network address- otherwise, nine or eight bytes.) and change the version number from 4 to 5 for example. Now here's what happens when the packet is passed through the DoD network which needs a version 4 header.

The packet arrives at the gateway node to the DoD network, the gateway node takes the 10 byte Amateur network source address and puts it in the option field, it takes the 10 byte Amateur network destination address and puts it in the option field, changes the lengths of the address fields to four bytes and inserts the DoD network source address and the DoD destination address information and finally changes the version number to 4. The version 4 packet is passed through the DoD network to its destination which is another gateway to an Amateur Radio network. This gateway transforms the version 4 packet back to version 5 by getting the information from the option fields and the packet is passed through the amateur radio network to its final destination with no one the wiser as to what happened. The transformation is a very simple matter. Whether or not the transformation is necessary, the gateway is still necessary to interface to the foreign network because knowledge of the addressing system of the foreign network must be kept somewhere and I don't think that users of the pass through facility should be required to have this knowledge. Also, some kind of physical interface is required as well.

You suggest reducing the complexity of the INTERNET standard by restricting the use of the fragmentation feature and you say,"The standard specifies a 576 byte maximum packet size." Actually the standard specifies that 576 bytes is the recommended minimum datagram size that will be accepted by a destination host. The maximum datagram size is 65,535 bytes. The standard recommends that datagrams larger than the minimum only be sent when it is known that the destination can handle them. This is only an agreement between source and destination and the implication is that all networks will be able to handle datagrams up to the maximum size either whole or by fragmenting them. In section 3.2 of the specification after the heading, 'Fragmentation and Reassembly." it says, "Every internet module must be able to forward

a datagram of 68 octets without further fragmentation." This implies that the network should not have to fragment a datagram unless it is over 68 bytes long. The LIPs we are using now meet this requirement because they handle packets as long as 250 bytes without fragmentation. I would agree with you in your proposal in this regard if it weren't for the possibility of the reverse situation occurring. You are mainly concerned with the Amateur networks making use of other networks such as the DoD network. What about the reverse situation where the DoD network wants to use the Amateur network? In this case our network would be receiving 576 byte packets destined for Amateur Radio hosts and potentially datagrams up to the maximum of 65,535 octets if the destination host is prepared to accept them. (see section 3.1 of the standard after the heading, 'Total Length:') The possibility exists that both source and destination hosts are in non-Amateur networks and the Amateur Radio network is only being used for pass-through. We would not have any control over the datagram size in this case. I think we'd better leave the fragmentation feature as it is if we want to interface with non-Amateur networks and advise all hosts to be able to handle datagrams up to 576 bytes if you envisage the situation where the source is in an Amateur network and the Destination is in a non-Amateur network or vice versa.

As far as the Service Type, Security Option, Stream ID, and Timestamps I agree that we do not need them but we must make provision for them in the gateway because packets coming out of the foreign networks we are using may require them even though we don't. We should make the gateway store these in the options when a packet comes into the Amateur network and return them to their proper location when leaving the Amateur network again. We can assign our own option numbers for this. I think the possibility of reciprocal use of other networks for pass through purposes should be maintained even though we may not be able to see the possibility immediately. For example, what if the DoD wanted to test the Amateur Radio network for possible use during an emergency situation? We wouldn't want them to lose their security information or to have our network refuse to deliver their 10,000 byte datagram or would we?

Some of the above comments are elicited by your own statement that we may want to interface with some already existing networks. I am mainly concerned with an Amateur network and I don't know how serious you are about using these other networks or what the possibilities really are but if you are really serious about it, we will have to make provisions for support for all the fields in the standard even if we don't use them ourselves for the benefit of these other networks. The full interfacing of these other networks to ours where we can access all the users and functions of a non-amateur network is not a trivial matter and requires analysis of all levels of protocol used in both systems and may prove to be impossible in some cases even with extremely complicated gateways. This is why I have mainly limited my responses to the use of these networks for pass through purposes. Your letter does not clearly explain the type of interface you envision.

Let me become philosophical for a moment. My original idea when I became involved with Amateur Radio Digital Communications was the creation of a purely Amateur Radio Digital Communications network

developed by Amateurs and for Amateurs using techniques and protocols tied directly to the needs of Hams. Unfortunately or fortunately, depending on your point of view, this pure ideal has not proven to be very popular. Many are concerned with interfacing or making the Amateur Radio network compatible with other existing networks. Interoperability has become a major desire expressed by many. In my opinion, by going this route, we are opening a large bag of snakes and limiting our potential at the same time. As for an Internetwork protocol, I think Amateur Radio needs to have one but at the same time I hope we never have to use it except for communication with a non-Amateur network. I can still hope even if I don't expect.

Finally, I would like to say that although I have some different proposals I don't consider them to be major objections to your own proposal for Amateur Radio's Inter-network standard. In fact, in the spirit of compromise, and at your insistence, I will agree to your original proposal in all details even though I don't think they may be the best solution. So there you have it, total agreement on your proposal if you want it. I only hope that you might after careful consideration see fit to adopt maybe one or another of my differing ideas expressed above. And now, since we have come to an agreement, maybe we can get some other group to agree on your proposal as well.

73 for now. I'll see you at the Conference in March.

Doug

Doug Lockhart, VE7APU/3